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FORSCHUNG Burgenland

RESEARCH & INNOVATION

Thermoelectric heat pump for heating and cooling in building services with low thermal power (Peltier_Heat_Pump)

SOLUTIONS gap 3 ENGINEERING SYSTEMS SERVICES

Stutterecker, Aschauer + Projektteam

Highlights der Energieforschung / 22.6.2016 / Wien

Introduction to the project Peltier_Heat_Pump

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- Thermoelectric heat pump for heating and cooling in building services with low thermal power
- The project is funded by the Austrian *Klima- und Energiefonds* within the funding scheme *Energieforschungsprogramm 2014*
- 30 month-> 5/15 until 10/17
- **Project leader:** Forschung Burgenland GmbH
- **Project partner:** Gap solutions GmbH

Thermoelectric devices – the Peltier element

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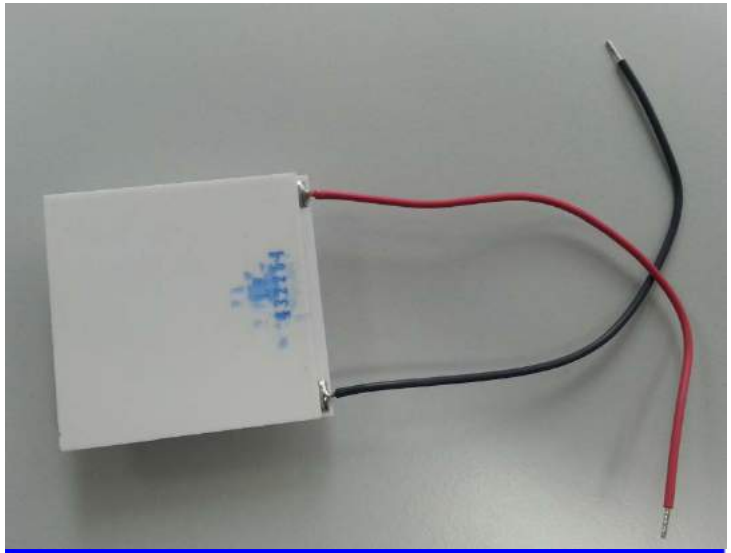

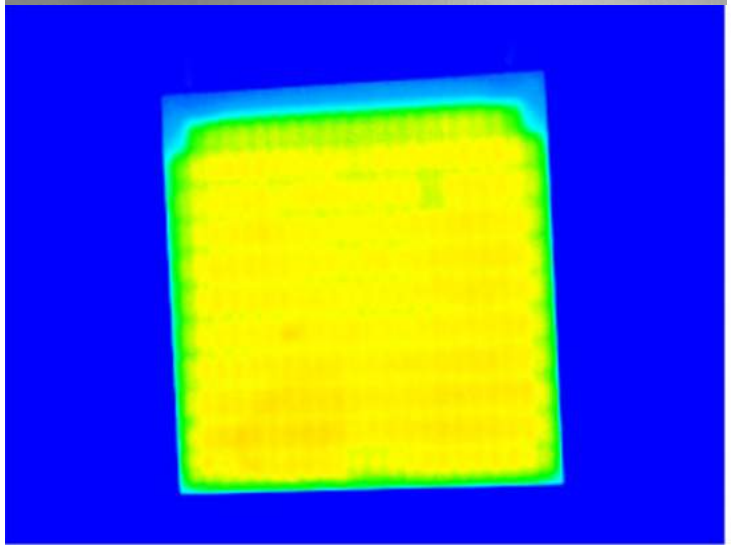

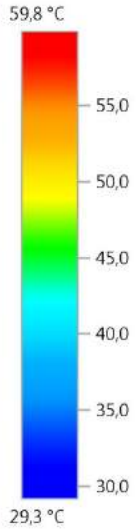

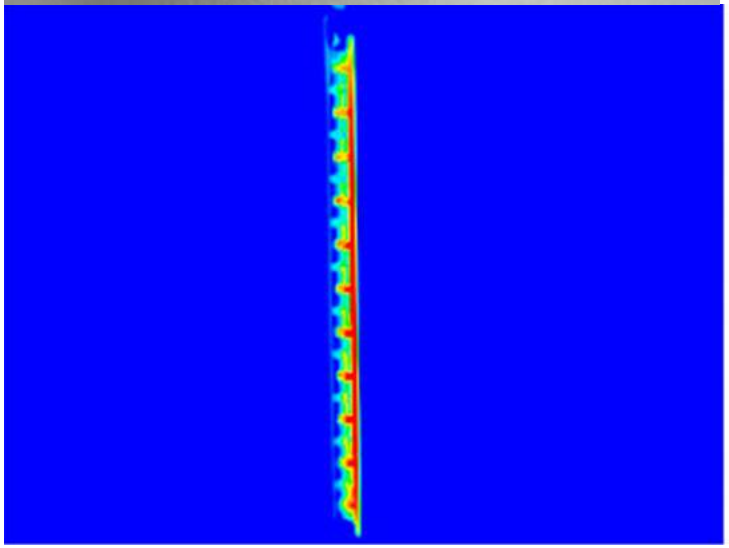

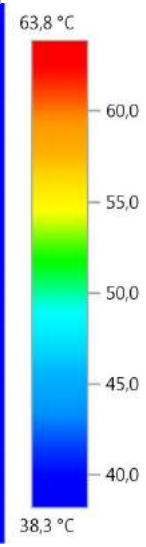

Performance data from a manufacturer

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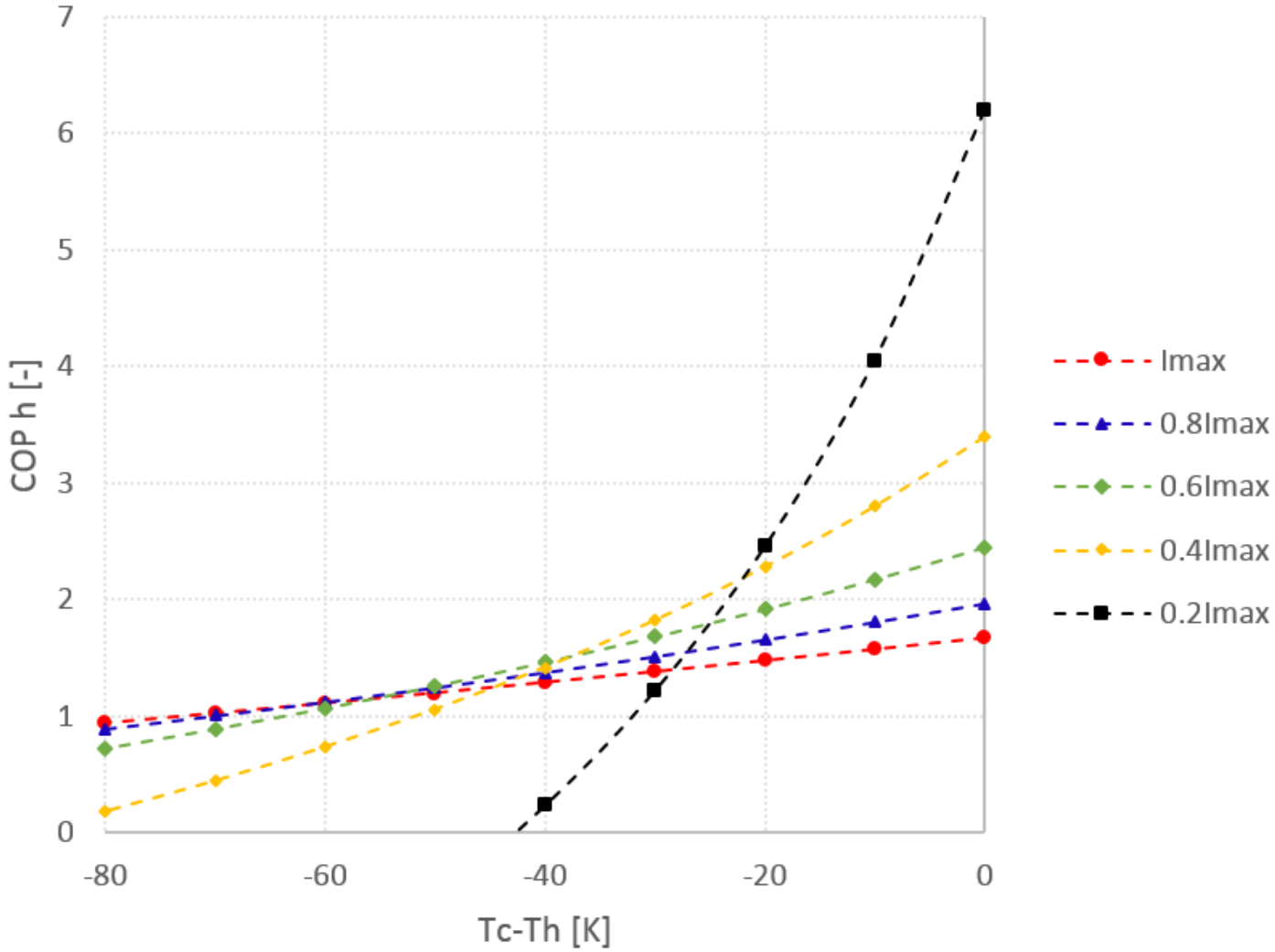


The aim of the project Peltier_Heat_Pump

- is to research a **device based on Peltier-elements for heating and cooling** in the building technology for small scale applications (<2 $kW_{thermal}$).

- This device is characterized
  - through long operation times and little electrical power consumption,
  - through operation without climate-relevant refrigerants,
  - through operation without noise emissions,
  - through operation without maintenance
  - and through the fact that it can be connected to PV without DC/AC conversion losses**.**

Method

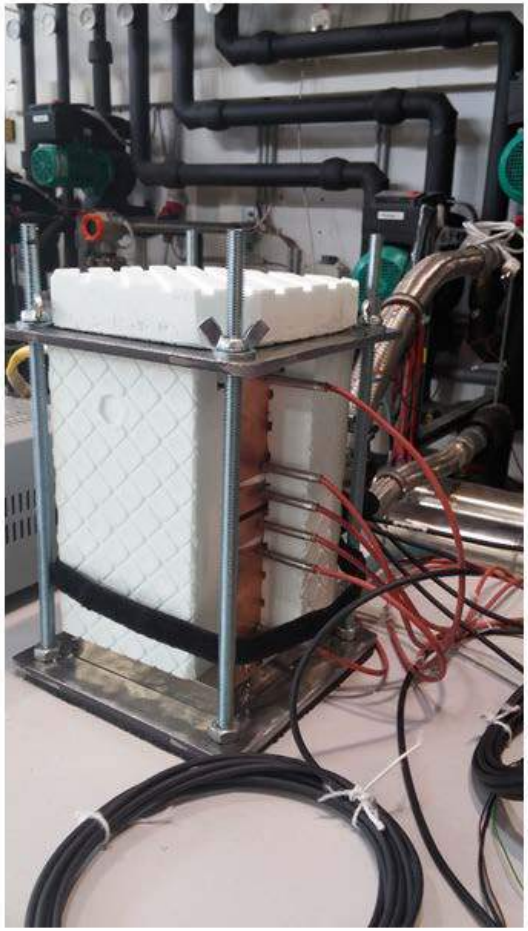
- **Calculation** of heat transfer between the thermoelectric element and the heat exchanger as well as between the external thermoelectric heat pump/ heat exchanger unit and the fluid through forced convection based on measurements.

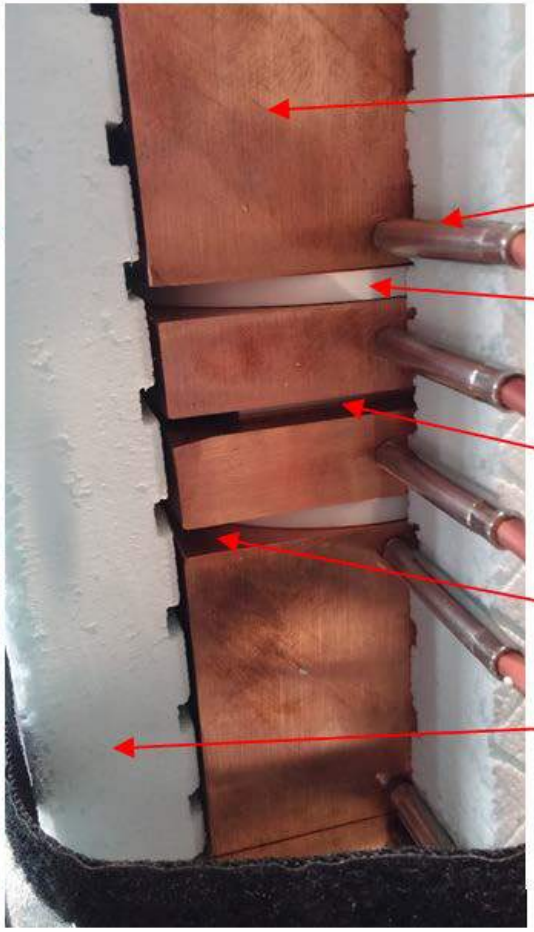
- **Laboratory experiment**
  - to evaluate different external thermoelectric heat pump/heat exchanger units for building technology applications
  - to validate the developed calculations

- **Hardware-in-the-loop simulation** at the existing heat pump test rig through the application of realistic loads and simulation of PV concepts

Test rig

- Test rig for thermoelectric modules

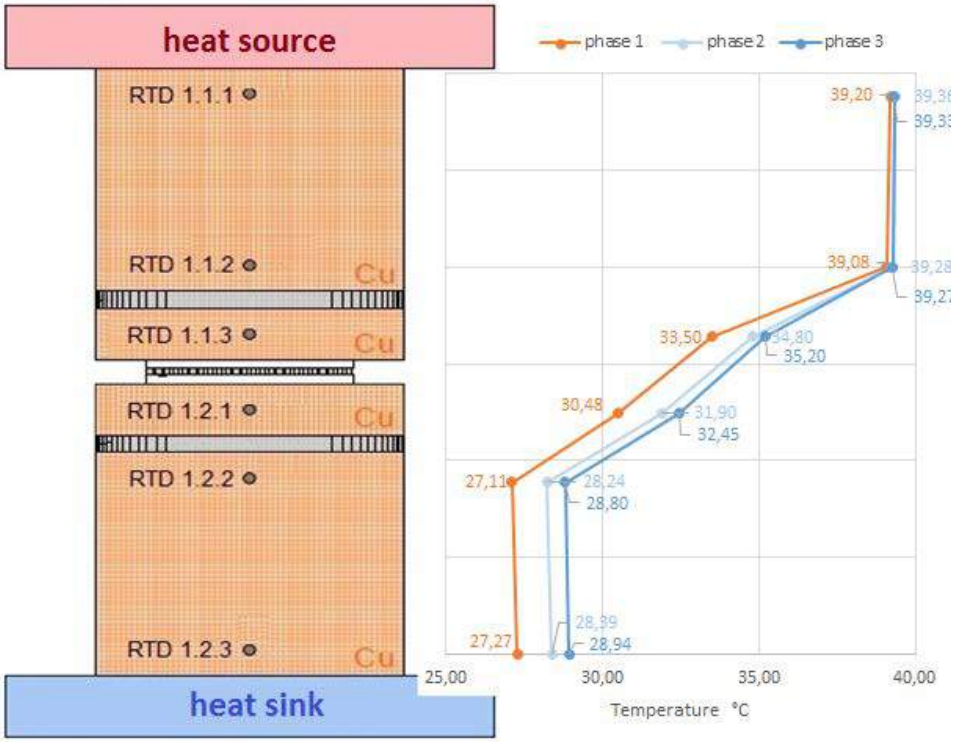




Test rig validation

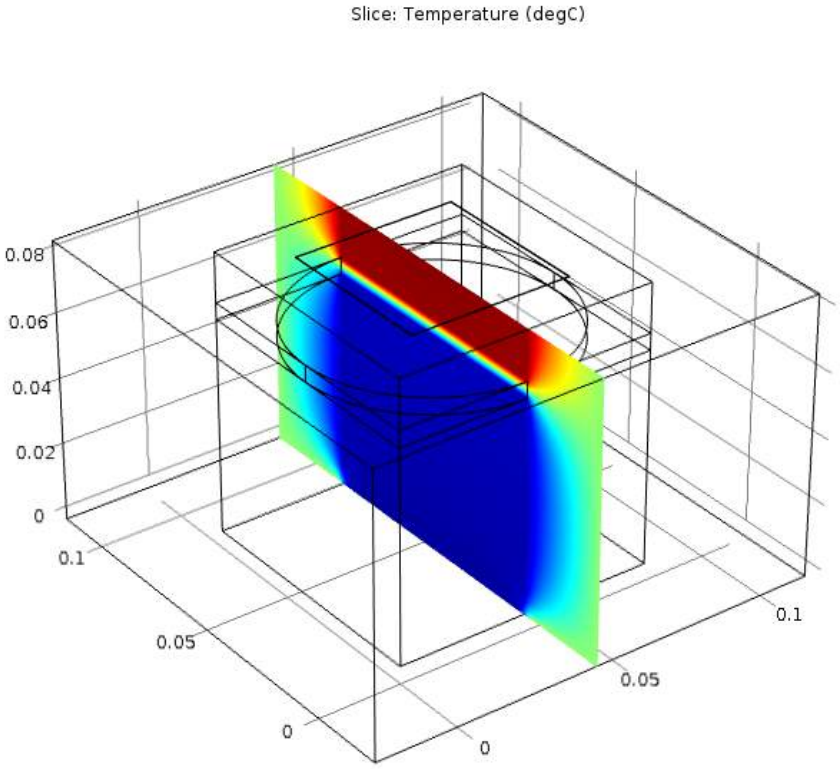
- **Influence of Insulation**

  Phase 1: without insulation Phase 2: 3 cm insulation Phase 3: 6 cm insulation



- **Simulation with COMSOL 5.2**

  Heat Transfer in a half of the test rig



Measurement of the functionality of the test rig

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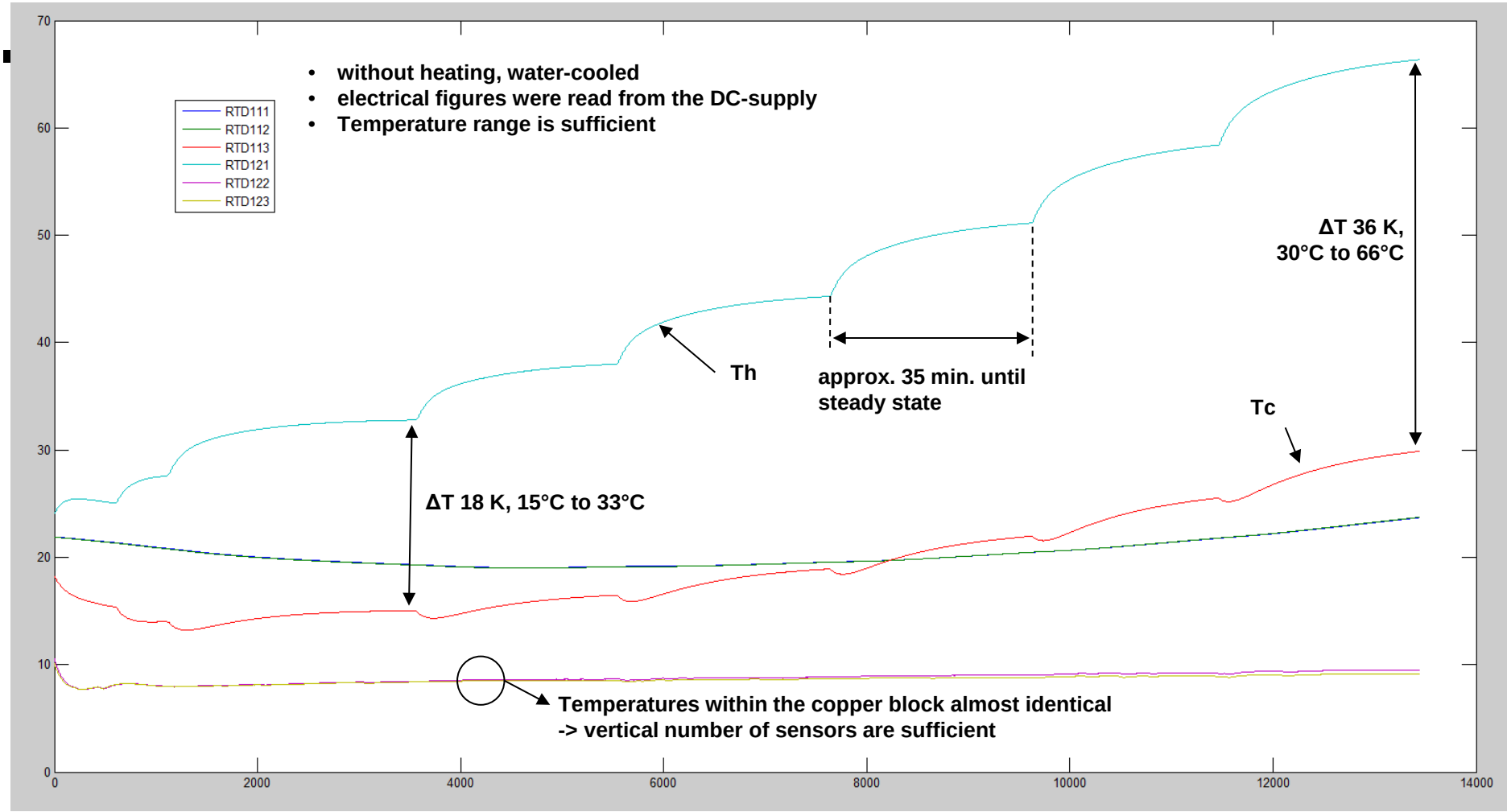

Test rig for TE heat pump / heat exchanger

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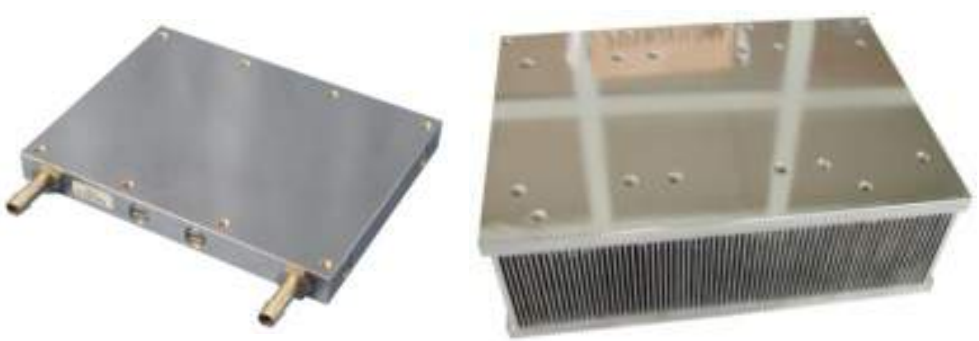
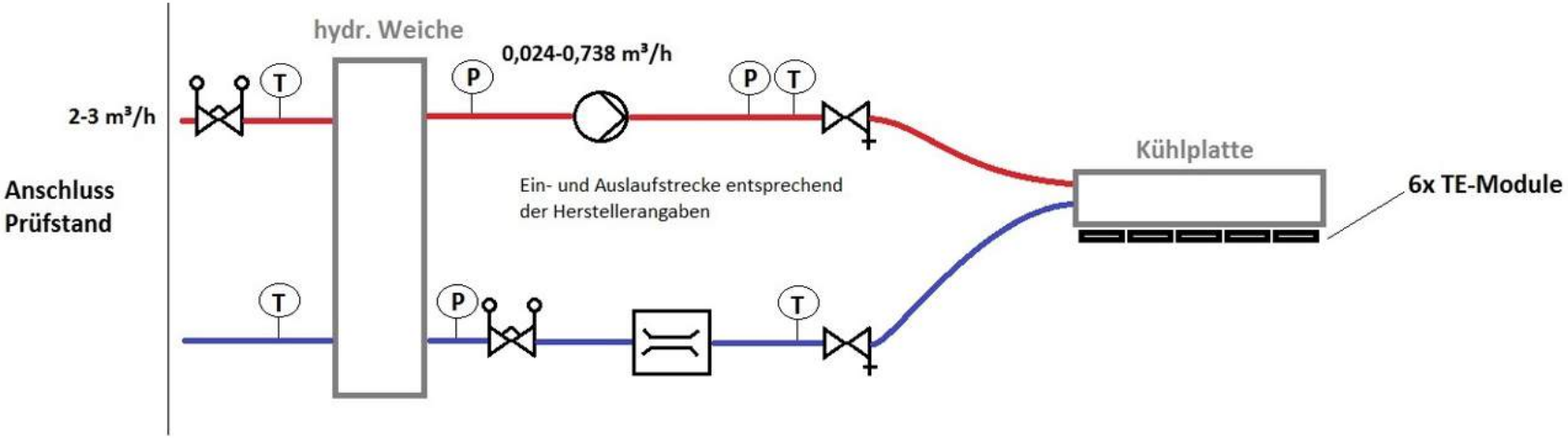


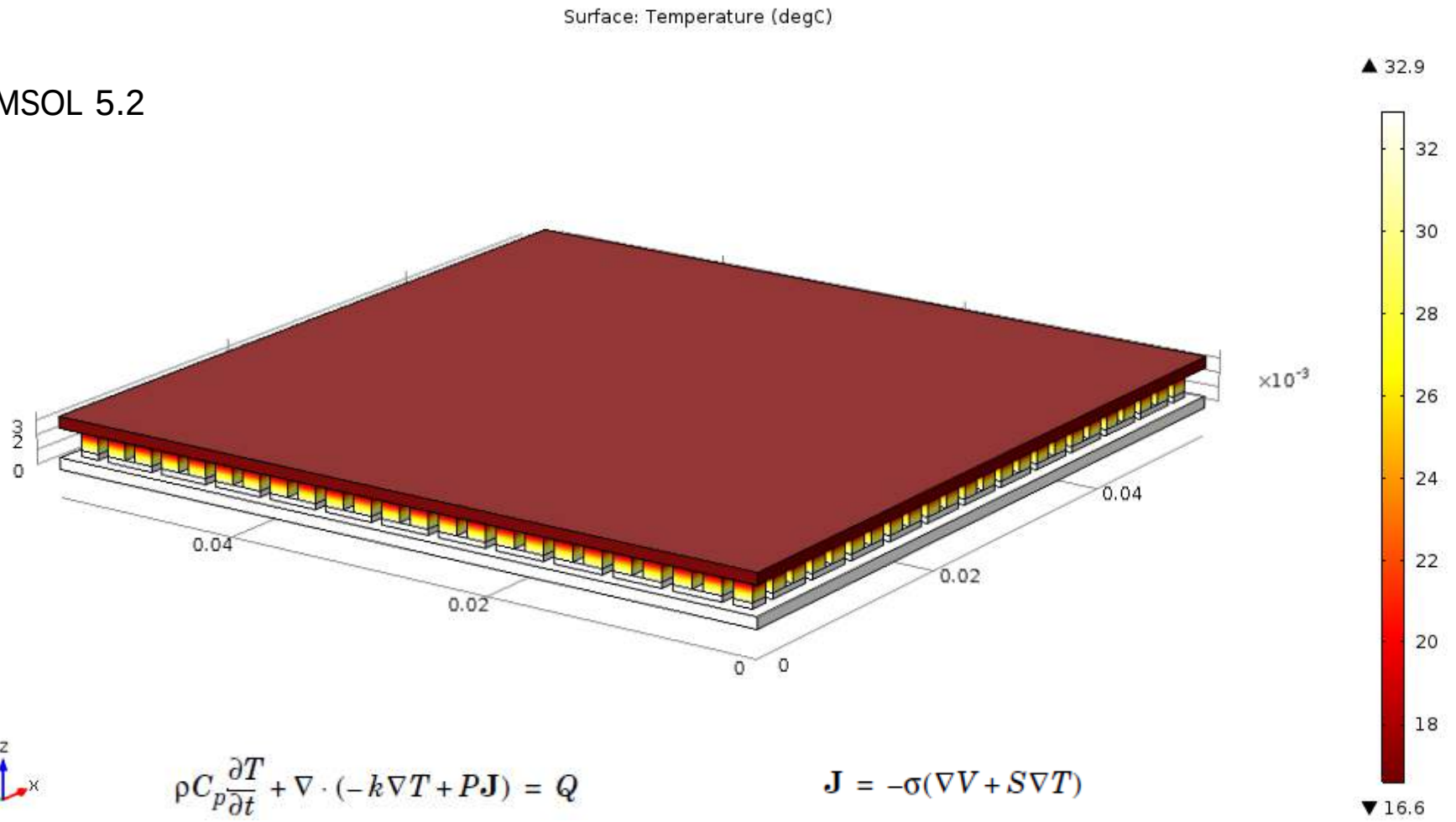
Quelle: Fa. Dau, www.dau-at.com

Quelle: Wilo – Geniax



Modelling of the thermoelectric modules (3D)

- COMSOL 5.2



$$\rho C_p \frac{\partial T}{\partial t} + \nabla \cdot (-k\nabla T + P\mathbf{J}) = Q$$

$$\mathbf{J} = -\sigma(\nabla V + S\nabla T)$$

Next steps

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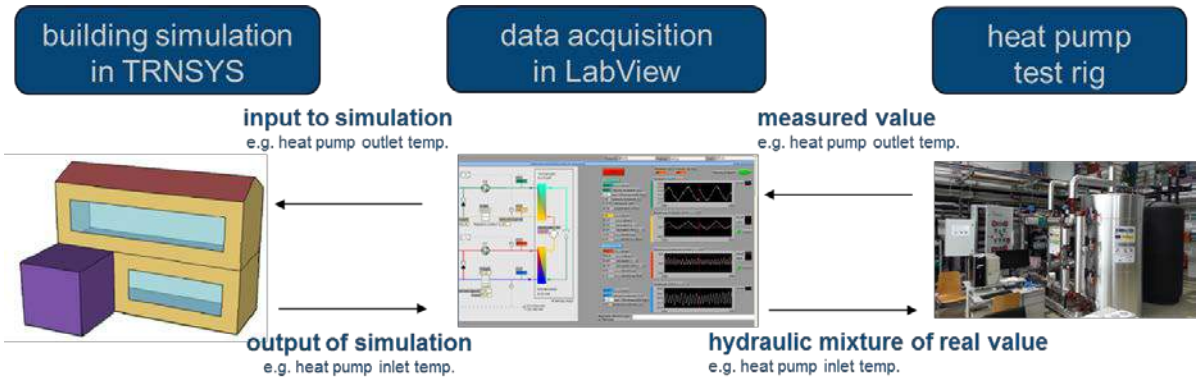
- Improvement of the test rig for single modules
- Development of a test rig for thermoelectric heat pumps
- Calculation and validation of different thermoelectric heat pump-concepts
- Hardware-in-the-loop simulation



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